PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in Devices for Fixing Tubes in Openings in Plates

We, SOCIETE POUR LE PERFECTIONNEMENT DU MATERIEL D'EQUIPEMENT AERONAUTIQUE (S.O.P.E.M.E.A) a Body Corporate organized under the laws of France, of Rond Point Victor Hugo, Issy Les Moulineaux, Seine, France, do hereby declare the invention for which we pray that a parent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a device for expanding thin tubes of small diameter for assembling them with the terminal plates of water or oil radiators or similar heat exchangers used in automobiles or aircraft in particular.

Devices of this character may be used for example for fixing tubes or pipes by cold forging in the openings provided to receive them in flanges or terminal plates of boilers, condensers, evaporators, heat exchangers or similar apparatus by permanent expanding these pipes or tubes (which are preferably of soft metal or metal which has previously been annealed) into intimate contact with the metal walls of the openings in the said flanges or plates.

When permitted by the internal dimensions of these tubes, use is frequently made of mechanical devices, such as conical rollers disposed around a driving shaft of equal and converse conicity which is displaceable longitudinally between these rollers in such manner that the external generatrices of these rollers apply their force inside the bore of the tube over a length corresponding to that of its required seating in the plate, and that this part of the tube is expanded into fluid-tight contact with the wall of the opening in the terminal plate.

Such a mechanical process can only be used with difficulty with tubes of small diameter and small thickness such as those used for radiators or other heat exchangers employed for example in automobiles and aircraft.

[*Price* :

The dimensions of these tubes do not permit the introduction of fairly robust devices and moreover the longitudinal forces and torsional forces due to the circular driving action used in these devices appear nor to be suitable for thin tubes.

Finally, it is obvious that, if it is possible with this process to expand tubes in openings which conform to a solid of revolution and which are not necessarily cylindrical, meeting meridianal contours other than those parallel to the axis, for example cylindrical with recesses or having curved generatrices, it is not possible to apply this process to contours which do not conform to a solid of revolution.

The object of the invention is to obviate these disadvantages and it is applicable to the thin tubes of radiators or other heat exchangers, without it being necessary for these tubes to be solids of revolution and fixed in round holes.

With this object in view, there is provided according to the present invention a device for fixing tubes in the openings of terminal plates receiving these tubes by expanding a portion of the tubes in the openings by means of a ring consisting of incompressible elastic material with a section permitting it to be introduced into the tube to be expanded, which device is characterised in that the said ring is disposed with radial clearance in a recess formed in a body of substantially the same external cross-section as the internal cross-section of the tube, this body comprising a supply for fluid under pressure communicating with the clearance between the said ring and the core forming the base of the said recess, in order to cause the expansion of the ring in the tube when this pressure is applied.

The invention will now be described by way of example with reference to the accompanying drawings, in which:—

Fig. 1 is a view of a hydraulically controlled expander head for expanding an

elastic ring positioned in the tube to be expanded.

Fig. 2 is a view of a similar hydraulic device with which it is possible to carry out the simultaneous expanding of the two ends of a tube in the seatings of two plates, each of which receives one of the said ends.

In these Figures, the same parts are indicated by the same numerals.

The device illustrated in Fig. 1 is suitable for mass production in cases where the tubes are very small.

In this device, an expander head which is introduced into a tube 1 positioned in an opening 2 in a plate 5, terminates in a guide portion 21 of ogival shape. The base 22 of the guide portion 21 has a cross-section similar to and, except for clearance, equal to the internal section of the tube 1.

This base 22 constitutes one side of an annular recess 23 formed in a cylindrical extension 24 of the same dimensions as 22, which is itself an extension of a rod 25 of larger dimensions, starting from a shoulder 26.

The recess 23 accommodates a ring 27 made of rubber of similar elastic and incompressible material which is of the same length as the recess, the cylindrical core 28 of the recess 23 extending through the centre of the ring. A clearance 29 is provided between the core 28 and the internal bore of the ring 27, the external dimensions of which, when at rest, re-establish the continuity between the nose of the guide portion 21 and the cylindrical extension 24 in order to extend with a small clearance in the tube 1.

The lengths of the ring 27 and the recess 23 are at least equal to those of the maximum thicknesses of the plates 5 for which the apparatus is provided.

The operative portion and the position of the front end surface of the rubber ring adjacent the base 22 are adjusted by means of a metal ring 31 of suitable length, which surrounds the excess length of the ring 27 while ensuring that the end of the tube 1 is flush with the external face 32 of the plate 5 and that the base 22 of the guide portion 21 and front end surface of the ring 27 are flush with the plane of the internal face 33 of the plate 5.

The rod 25, which is hollow at 34, is extended by a small diameter passage 35 to the interior of the core 28 and this passage terminates an at least one orifice 36 opening into the clearance 29 between the ring 27 and the core 28.

When the tool has been introduced into the tube 1, this introduction being facilitated by the guide portion 21, and when the ring 31 has been positioned so that it is in contact with the surface 32 and with the tube 1 which is flush therewith, the said tool is positioned as shown in Fig. 1.

If a pressure 37 is then set up in the hollow space 34, for example by means of oil under pressure supplied by known means (not shown) this pressure on reaching the clearance 29 will force the ring 27 to increase its external diameter, thereby forcing the tube 1 against the wall of the opening 2, and if the pressure 37 is sufficient, it will cause perfect expansion of the tube 1 in the opening 2.

The advantages of such an arrangement are obvious: The dimensions of the tube 1 can be very small, and the tractive forces on the core 28 can be small if the clearance 29 is itself reduced.

Introduction is simple, owing to the guiding action provided by the guide portion 21 and adjustment of the depth of introduction is made exact by choosing a ring 31 of suitable length.

The action, which consists in admitting pressure 37 into the hollow space 34, is very quick. This action can easily be controlled by a pressure gauge connected to the hollow space 34. If the pressure 37 is regulated to suit the type of tube 1 being operated on, the expanding operation is automatically carried out in a satisfactory manner.

By simply replacing the ring 31 by another ring of suitable length, a single tool can be used on plates 5 having different thicknesses, in order that tubes 1 of an internal diameter adapted to the tool may be fixed therein by an expanding operation. This tool can be operated on tubes of different thicknesses simply by regulating the pressure 37 so that it is sufficient for the thickness of the tube to be expanded. The sections of the tube 1 and opening 2 can be other than circular, this permitting the expanding of drawn radiator tubes or any desired cross-section such as a streamlined or other cross-section, if desired.

Fig. 2, in which the same reference numerals are used, shows diagrammatically that it is possible, in a single operation, to effect the expansion of the two ends of the tube 1 in two spaced plates 5 by providing two rubber rings on a single tool so that they can be expanded by way of the same pressure line.

Although it is not necessary to illustrate this, it will be understood that the small transverse dimensions of such a device permits the design of multiple tools for mass production, which tools permit the simultaneous expanding of complete rows of tubes and even of all the tubes of a radiator or other heat exchanger, it being possible for this expanding operation to be carried out at a uniform pressure, which can be controlled by means of a single pressure

gauge connected by a branch duct to the pressure source. There is nothing to prevent the internal surface of each aperture 2 being provided with grooves or contours with non-rectilinear generatrices in order to ensure a better longitudinal anchoring with the tubes 1 which are expanded therein.

WHAT WE CLAIM IS:—

1. A device for fixing tubes in the openings of terminal plates receiving these tubes by expanding a portion of the tubes in the openings by means of a ring consisting of incompressible elastic material with a section permitting it to be introduced into the tube to be expanded, characterised in that the said ring is disposed with radial clearance in a recess formed in a supporting body of substantially the same external cross-section as the internal cross-section of the tube, this body comprising a supply of fluid under pressure communicating with the clearance between the said ring and the core forming the base of the said recess, in order to cause the expansion of the ring in the tube when this pressure is applied.

2. A device as claimed in claim 1, wherein the ring has disposed in front thereof, for its convenient introduction, a portion of the profiled supporting body which tapers at its end and is joined tangentially to the profile of the body in which is formed the recess.

3. A device as claimed in claim 1, wherein a thick metal ring mounted on the supporting body determines the extent to which the incompressible elastic ring can be introduced into the tube, the said thick metal ring being formed with a bore corresponding to the external form of the incompressible elastic ring when at rest and of the supporting body, but abutting at the rear end against a shoulder of the said body.

4. A device as claimed in claim 1, wherein the said supporting body is provided with a plurality of incompressible elastic rings which have lengths and spacing determined for the simultaneous expansion of a single tube in openings formed in several supporting plates.

5. A device as claimed in any of the preceding claims, wherein there are a plurality of supporting bodies combined to form multiple tools for the simultaneous expansion of several tubes.

6. A device for fixing tubes in the openings of terminal plates receiving these tubes by expanding a portion of the tubes in the openings, substantially as hereinbefore described with reference to Figure 1 or 2 of the accompanying drawings.

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853,630 COMPLETE SPECIFICATION
1 SHEET
This drawing is a reproduction of the Original on a reduced scale.

Fig. 1.

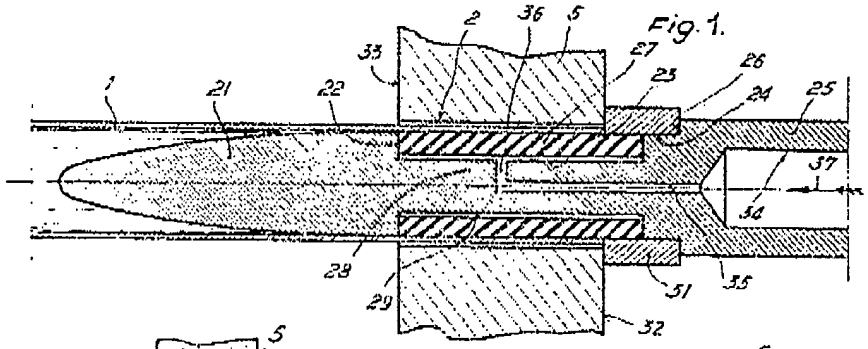

Fig. 2.